



Payload Operations Integration Working  
Group (POIWG)  
July 22, 2015

**Human Research Program  
(HRP)**

**Rochelle Brown & Marc Perry**

## HRP Increment 47/48 Overview

Increment Manager  
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## **AGENDA**

- HRP Experiment Complements
- Other In-Flight Activities
  - Facility Activities
  - Support to Med Ops and IP Activities
- Challenges
- Backup Charts: Investigation Summaries



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## **MISSION HIGHLIGHTS**

- No new experiments for this Increment 47/48 pair
- 4 Fluid Shifts subjects
  - 2 on 46S
  - 2 on 47S
  - 3 sessions to execute in the Increment pair
- Conclusion of the Cognition, Ocular Health, and Salivary Markers studies



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## HRP Inc 43/44 Complement

### In-Flight Experiments

- Biochemical Profile
- Body Measures
- Cardio Ox
- Cognition **(45S)**
- Dose Tracker
- Fine Motor
- Fluid Shifts
- Habitability
- Microbiome
- NeuroMapping
- Ocular Health **(45S)**
- Repository
- Salivary Markers **(43S)**
- Sprint (Active)
- Sprint (Control) **(45S)**
- Sprint (Data Share Only)

### Previous Increments

37/38 – 45/46	
37/38 – 45/46	
37/38 – 45/46	
41/42 – 45/46	Final Subject
46	
43/44 – 45/46	
43/44 – 45/46	
43/44 – 45/46	
35/36 – 45/46	
41/42 – 45/46	
35/36 – 45/46	Final Subject
16 – 45/46	
37/38 – 45/46	Final Subject
27/28 – 45/46	
31/32 – 45/46	Final Data Collection
27/28 – 45/46	



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## **HRP Inc 47/48 Complement - cont.**

### Pre/Post Only Experiments

- Field Test
- **Telomeres**

### Previous Increments

43/44 – 45/46  
43/44 – 45/46\*

\* Transition from an in-flight to a pre/post implementation beginning with the 45S crew



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## Participation Matrix for HRP Experiments (In-flight)

Experiment	45S US	45S ESA	46S US	46S RS	47S US	47S JAXA	47S RS
Biochem Profile	✓	✓	✓		✓	✓	
Body Measures			✓		✓	✓	
Cardio Ox	✓	✓	✓		✓	✓	
Cognition	✓	✓					
Dose Tracker	✓	✓	✓		✓	✓	
Fine Motor Skills	✓	✓			✓	✓	
Fluid Shifts	✓		✓	✓		✓	✓
Habitability	✓	✓	✓		✓		
Microbiome	✓						
NeuroMapping	✓		✓		✓		



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## Participation Matrix for HRP Experiments (In-flight) – cont.

Experiment	45S US	45S ESA	46S US	46S RS	47S US	47S JAXA	47S RS
Ocular Health	✓	✓					
Repository	✓	✓	✓		✓	✓	
Salivary Markers	✓						
Sprint	✓ CONTROL		✓ ACTIVE		✓ DATA SHARE	✓ DATA SHARE	



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## Participation Matrix for HRP Experiments (Pre/Post Only)

Experiment	45S US	45S ESA	46S US	46S RS	47S US	47S JAXA	47S RS
Field Test			✓		✓		
Telomeres	✓	✓				✓	

Experiments to be added to the I47/48 complements via the delta Informed Consent process :

- Bisphosphonates Control (one 47S crewmember)
- Body Measures (47S JAXA as insurance subject)

A briefing will not be required since those experiments were pitched to the crew as backups.





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## **HRP Inc 47/48 Facility Activities**

- HRF PCs upgrade to Build 15
- RIC 10.0 Install
- GDS/PFS Gauge Photos
- HRF Supply Kit Resupply & Inventory
- PFS Gas Monitoring System (GMS) Calibration
- PFS Relief Valve C/O
- SLAMMD Maintenance
- USND2 Maintenance



### HRP Support to Med Ops

- HRF and Ultrasound for Ocular Scan
- Targeting all crew (Under Review)



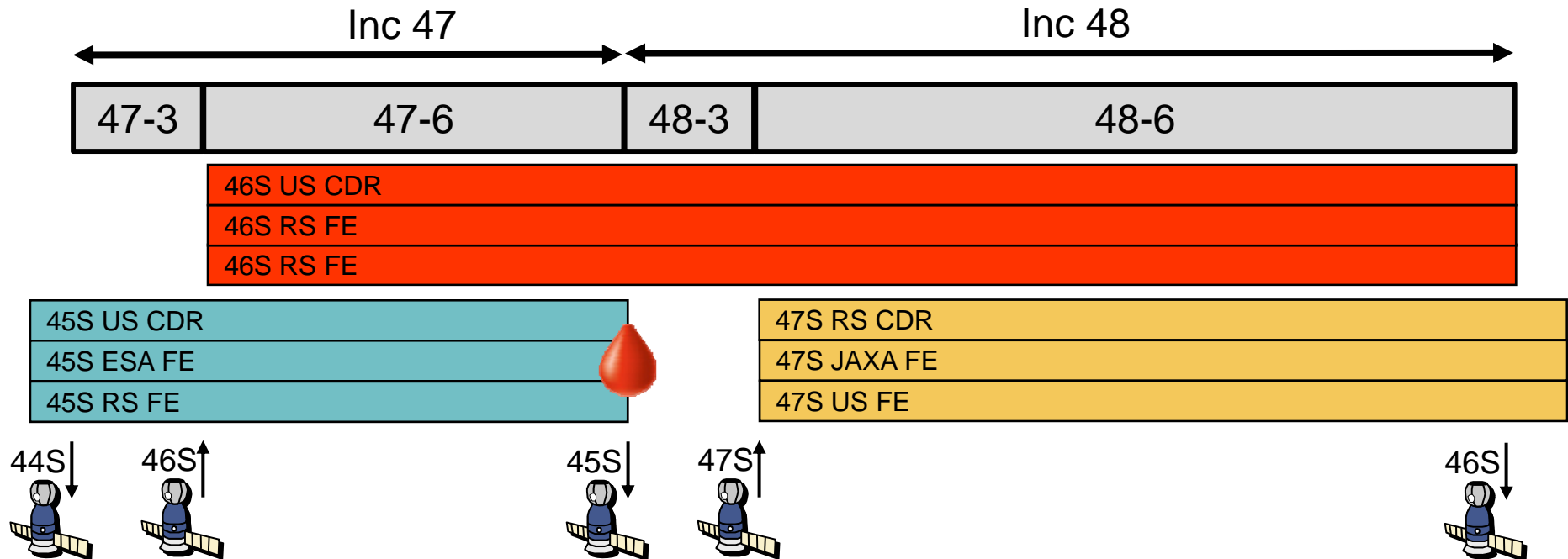


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## HRP Ambient Sample Returns



- Ambient 45S US FE blood return possible for Salivary Markers and Microbiome R-1
- Currently this subject is reserve for Inc. 45/46
- Carries a 48 hours return requirement so a contingency sample return logistics plan would be required



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## **HRP Inc 47/48 Support to IP Science**

### **CSA**

- **Marrow:** ICB, Training, Data Sharing Agreements, RC, Impact Procedures updates and inputs, and blood draw consumables
- **Vascular Echo:** ICB , Training, Data Sharing Agreements, RC, USND2, Impact procedure reviews, Experiment Sequence Test

### **ESA**

- **Airway Monitoring:** Uses HRF PuFF Calibration Syringe
- **Energy:** Training, BDC, Data Sharing Plan, Impact Procedures, HRF PFS software maintenance

### **JAXA**

- **Biological Rhythms 48:** Uses Actiwatch Reader & Cable



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## **HRP Inc 47/48 Use of IP Hardware**

### **ESA HW**

- **Sprint** – Portable Pulmonary Function System (PPFS)
- **Fluid Shifts** – CDL HLTA BP device

### **Russian HW**

- **Fluid Shifts:**
  - Chibis Lower Body Negative Pressure system
  - GAMMA medical monitoring system
  - 28VDC to 120VAC Power Inverter
  - Power Distribution Unit (PDU)



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## **HRP Strategies for Inc 47/48 Implementation**

- Ensure that blood and urine collections are as efficient as possible for participating crew and provide an execution strategy to the crew prior to launch.
- Manage the rolling blood volume limits for the crew by providing comments to the preliminary and final OOS as necessary
- Utilize Increment 45/46 manifests to appropriately pre-position hardware and resupply consumables



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## **HRP Inc 47/48 Forward Work/Challenges**

- Fluid Shifts
  - PI and MHRPE agreements to the Program Science Office by late-August
  - Fluid Shifts Training and BDC scheduling on Russian subjects
- Addition of the Vein Press facility hardware to the Fluid Shifts measures



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# Back Up Slides



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## **Pre-/Post- Investigation Summaries**

### **Field Test (new):**

NASA PI: Millard F. Reschke, Ph.D.

**Brief Research Summary:** The Field Test is made up of studies designed by the Neuroscience and Cardiovascular Laboratories at NASA's Johnson Space Center and the Institute of Biomedical Problems, Moscow, Russia to investigate changes in human physiology that affect returning astronauts and cosmonauts following space flight missions lasting from six months to one year. Changes in vision, balance, coordination, blood pressure and even the ability to walk have a substantial impact on the way very basic and fundamental tasks are performed. The Field Test experiment is designed to measure the complexity, magnitude, duration and recovery of these changes in order to better understand the kind of treatment that is necessary to speed-up recovery and prevent injury to our astronauts.

### **Data Collection:**

- Three pre-flight sessions and garment measuring
- Three landing day sessions – at approximately 2 - 5 hours, 10 hours, and 24 hours after landing
- Five post-flight sessions – 1, 4, 6, 15 and 30 days after landing





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## **Investigation Summaries**

### **Biochemical Profile:**

Scott M. Smith, Ph.D.

**Brief Research Summary:** Blood and urine are commonly used to assess an astronaut's health as well as conduct research in physiological disciplines by measuring key biomarkers found in these fluids. In support of research studies, this project will collect, process and store blood and urine samples obtained during the preflight, in-flight and postflight phases of ISS missions and maintain a database of results from the analysis of these samples. This database will offer supporting evidence to scientists by providing metabolic profiles of the effects of spaceflight on human physiology.

**In-Flight Data Collection:** 24-hour urine collection, blood draw and subsequent processing.



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## **Investigation Summaries**

**Bisphosphonates (Control):** Adrian Leblanc, Ph.D. & Toshio Matsumoto, Ph.D.

**Brief Research Summary:** Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss. The purpose of the Bisphosphonates study is to determine whether an antiresorptive agent, in conjunction with the routine in-flight exercise program, protects International Space Station (ISS) crewmembers from the regional decreases in bone mineral density documented on previous ISS missions.

Control subjects will not ingest the bisphosphonate pill in order to provide a comparison.

**In-Flight Data Collection:** 24-h Urine collection, Diet/Exercise Logs



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## **Investigation Summaries**

### **Body Measures:**

Sudhakar Rajulu, Ph.D.

**Brief Research Summary:** Currently, NASA does not have sufficient in-flight anthropometric data (body measurements) gathered to assess the impact of physical body shape and size changes on suit sizing. This study will involve collecting anthropometric data (body measurements) using digital still and video imagery and a tape measure to measure segmental length, height, depth, and circumference data for all body segments (i.e., chest, waist, hip, arms, legs, etc.) from astronauts for pre-, post-, and in-flight conditions.

**In-Flight Data Collection:** Circumference measurements with a tape measure along with photographic and video imagery.



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## Investigation Summaries

### **Cardio Ox:**

Steven H. Platts, Ph.D.

**Brief Research Summary:** Future human space travel missions may increase the risk of oxidative and inflammatory damage primarily from radiation, but also from psychological stress, reduced physical activity, diminished nutritional standards and exposure to altered oxygen levels during extravehicular activity. There is evidence that higher levels of oxidative and inflammatory stress and associated damage to blood vessels contribute to cardiovascular disease. The purpose of this study is to measure levels of biomarkers in blood and urine that are affected by oxidative and inflammatory stress before, during, and after long duration spaceflight and relate them to the risk of developing atherosclerosis.

**In-Flight Data Collection:** Ultrasound scans (carotid/brachial) with ECG recording, blood draw and 24-h Urine collection.



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## Investigation Summaries

### **Cognition:**

Mathias Basner, Ph.D., M.D., MSc

**Brief Research Summary:** Given the breadth of neurocognitive functions required for effective performance in space, the need to medically manage sleep and fatigue in space, the very limited neurocognitive assessment tools currently in space flight, and the often anecdotal nature of cognitive complaints from space flight, there is a critical need for rapid objective assessment of a range of neurocognitive performance functions in space flight. This project will achieve this goal by developing a much-needed practical, yet comprehensive cognitive test battery, validating its sensitivity to fatigue and fatigue countermeasures, determining astronaut norms for the test battery, and establishing space-flight feasibility of the battery.

**In-Flight Data Collection:** Cognition consists of 10 brief cognitive tests, each 1-3 minutes in length. The tests will be performed 11 times in-flight. Crewmembers will perform tests on the following days: 4 times early in-flight with a 1-week interval (FD 6, 13, 20, 27), 7 times later in-flight at 19-day intervals (FD 46, 65, 84, 103, 122, 141, 160).



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### NeuroMapping:

Rachael Seidler, Ph.D.

**Brief Research Summary:** This research is being conducted to identify if there are any changes in brain structure, function, and network integrity as well as human motor control, spatial processing and multi-task performance abilities as a function of long-duration spaceflight. It will also determine how long it would take for the human body / brain to recover from such adaptations. This research will help generate relationships between structural and functional brain changes, correlated to human performance over time.

**In-Flight Data Collection:** Subset of behavioral assessment tests will be performed including a mental rotation test, dual task test, and a joystick-based sensorimotor adaptation test. Three (3) in-flight sessions are required on FDs 30, 90, and 150 (flexibility +/- 10 days). Each in-flight session will require 50 minutes of crew time. In-flight sessions will utilize the existing HRF PCs and ESA's universal serial bus (USB) joystick.



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## Investigation Summaries

### Ocular Health:

Christian Otto, M.D.

**Brief Research Summary:** The International Space Station (ISS) Ocular Health Protocol aims to systematically gather physiological data to characterize the Risk of Microgravity-Induced Visual Impairment/Intracranial Pressure on crewmembers assigned to a 6 month ISS increment. The data collected will mirror Medical Requirements Integration Documents (MRID) requirements and testing performed during annual medical exams with an increase in the frequency of in-flight and post flight testing to more accurately assess changes that occur in the visual, vascular, and central nervous systems upon exposure to microgravity and the resulting fluid shifts. Monitoring in-flight changes, in addition to post flight recovery, is the main focus of this protocol.

**In-Flight Data Collection:** Fundoscopy, Tonometry, Visual Testing, Ocular Ultrasound, BP and Vascular Compliance (cardiac ultrasound, BP, EKG)



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## Investigation Summaries

### **Repository:**

Kathleen A. McMonigal, M.D.

**Brief Research Summary:** The NASA Biological Specimen Repository is a storage bank that is used to maintain biological specimens over extended periods of time and under well-controlled conditions. This repository supports scientific discovery that contributes to our fundamental knowledge in the area of human physiological changes and adaptation to a microgravity environment and provides unique opportunities to study longitudinal changes in human physiology spanning many missions. Samples from the International Space Station (ISS), including blood and urine, are collected, processed and archived during the preflight, in-flight and postflight phases of ISS missions. This investigation archives biosamples for use as a resource for future space flight related research.

**In-Flight Data Collection:** 24-hour urine collection, blood draw and subsequent processing.





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## Investigation Summaries

### **Salivary Markers:**

Richard J. Simpson, Ph.D.

**Brief Research Summary:** The Salivary Markers investigation involves the collection of blood, saliva, urine and a health assessment on six subjects pre-, in- and post-flight to determine if spaceflight induced immune system dysregulation increases infection susceptibility or poses a significant health risk to crewmembers onboard the International Space Station. The investigation utilizes a longitudinal, repeated measures design to determine the effects of long-term exposure to microgravity on a host of salivary antimicrobial proteins (AMPs), latent viral reactivation, antibacterial properties of saliva, and blood markers associated with innate host immune defense.

**In-Flight Data Collection:** Blood draw, Saliva sampling, 24-hour urine collection, and Health Assessment using Med Ops' Data Collection Tool (DCT). FD 90 and R-1 blood samples will return ambient on Soyuz



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## Investigation Summaries

### **Sprint (Active and Control):**

Lori Ploutz-Snyder, Ph.D.

**Brief Research Summary:** The Sprint experiment evaluates the efficacy of exercise countermeasures; this includes detailed measurements of cardiovascular and muscle function and bone health and evaluates the effectiveness of a new exercise prescription integrating both resistance and aerobic training exercise.

Control subjects will follow the standard ISS exercise protocol and share exercise data with the Sprint Principal Investigator.

**Data Collection:** Pre-/Post-flight testing: involves DXA, QCT, MRI, Muscle Performance and Isokinetic testing. Muscle biopsies are optional. In-flight testing for Active subject: Sprint exercise protocol. In-flight testing for Active subjects and added to Control subjects beginning Inc 39/40: VO2 Max and Ultrasound muscle volume scan.